CHAPTER 3

PRECEDENCE DIAGRAMING SYSTEM

Precedence Diagraming

a. Activities. The activities or work items in precedence are shown in a block (Figure 3-1). The description of the activity is usually shown in the top of the block as indicated with spaces provided for activity identification number and the duration also. Durations are estimated amounts of time that the activity is expected to take. Durations are usually expressed in work or calandar days but can be expressed in other units of time. Each activity is assigned a unique work item identification number which can be sequential but need not be.

b. Logic Diagraming. The considerations for precedence logic diagraming include three factors which should be considered:
(1) What must be finished before this activity can be started?
(2) What work can proceed concurrently with this activity?
(3) What work cannot start until this activity is finished?
When these questions are satisfied, activities can be arranged in logical sequence. Precedence relationships are indicated by a series of arrows between activities. They define the relationship between the activities and they indicate interdependence but do not represent work. In this aspect precedence diagrams are relatively easy to construct. A sample precedence diagram is shown at Figure 3-2. B, C, and D cannot start until A is finished and B, C, and D are parallel or concurrent with respect to each other. However, in addition to the capability of relating the finish of one activity to the start of the next the start of one activity can be related to the start of another or the finish of one activity to the finish of another. A start to start relationship as depicted in Figure 3-5 in precedence indicates that the start of A must precede the start of B. Similarly, a finish to finish relationship indicates that the finish of A must precede the finish of B in Figure 3-6.

c. Lag Factors. The relationships mentioned above may be assigned time factors. While a finish to start relationship usually does not have a lag, it can (see Figure 3-4). Start to start and finish to finish relationships usually are assigned lag factors as indicated by the 3-day lags in Figures 3-5 and 3-6.

d. Manual Analysis. This is rarely done when working with precedence diagraming; however, it can be useful for illustration. Relationships, when assigned time factors, must be considered in the analysis forward and backward passes. Such lag factors often dictate early and late starts and finishes. When doing a precedence

GENERAL INFORMATION - PRECEDENT SYSTEM

A. Elements of the System.

1. Activity/Work Item: Includes description, duration, and work (Number Identifier) enclosed in a node rather than shown on an arrow generally indicated similar to:

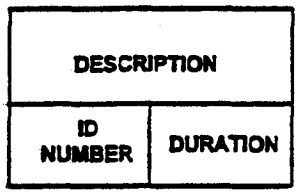


Figure 3-1

2. Logic Information: Indicated by position of nodes in relation to each other, arrows are used to identify dependencies between nodes/activities.

B. Example of a Diagram: (A, B, C, D, E, F, and G are activities.)

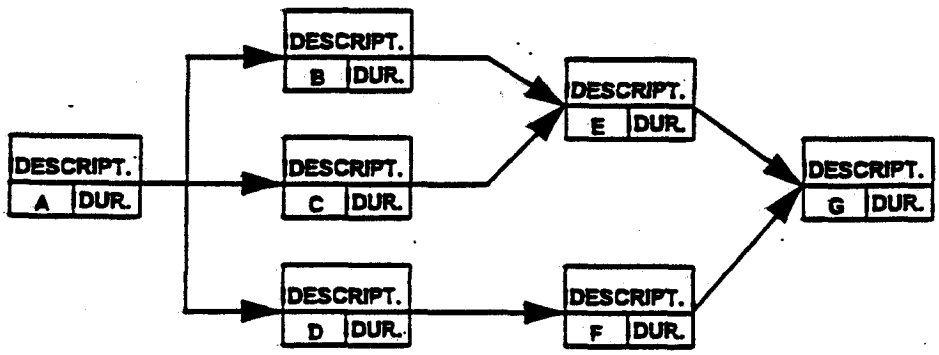


Figure 3-2

C. Example of Dependencies:

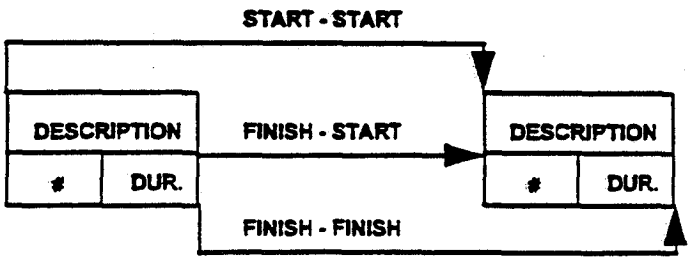


Figure 3 -3

PRECEDENT ACTIVITY DEPENDENCY RELATIONSHIPS WITH "LAG" FACTORS

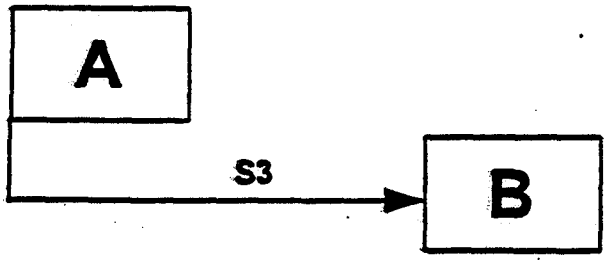
A.

FINISH TO START RELATIONSHIP (WITH LAG)

EXAMPLE: CONCRETE PLACEMENT [A] MUST BE FINISHED 3 DAYS BEFORE FORMS CAN BE STRIPPED [B]

Figure 3-4

B.

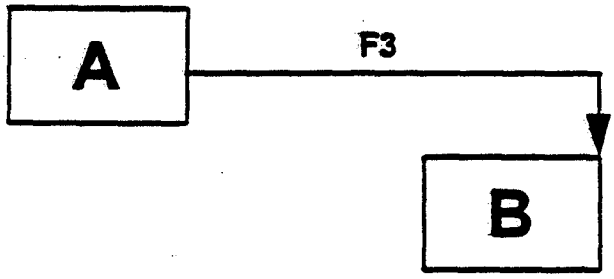


START TO START RELATIONSHIP (WITH LAG)

EXAMPLE: FORMS MAY BE STRIPPED [B] 3 DAYS AFTER THE START OF CONCRETE PLACEMENT [A]

Figure 3-5

C.



FINISH TO FINISH RELATIONSHIP (WITH LAG)

EXAMPLE: FORM STRIPPING [B] CANNOT BE FINISHED UNTIL 3 DAYS AFTER THE FINISH OF CONCRETE PLACEMENT [A]

Figure 3-6

forward pass, if a selection is required between the results of two calculations, the larger answer is selected. Similarly, in a precedence backward pass a selection is resolved by selecting the least of the values indicated. Conventionally, the Early Start (ES), Early Finish (EF), Late Start (LS), and Late Finish (LF) are shown as indicated on the sample activity in Figure 3-7. One should note that the lag factors between activities can influence the starts and finishes to the extent that the (ES) and (EF) for an activity may not differ by the activity duration and, likewise, the (LS) and (LF) may not.

e. The Critical Path. In a precedence network the critical path consists of a chain of activities controlling the length of the project. In addition, if start to start or finish to finish relationships are included, the critical path may include some of these lag times. An activity or the critical path will display the characteristics of equal early and late start and finish dates and the difference between the start and finish equal to the duration. If, however, a start to start or a finish to finish relationship is critical, the start of an activity may be critical but not the finish. Likewise, the finish may be critical but not the start. Note Activities 6 and 9 on Figure 3-7 evince these conditions.

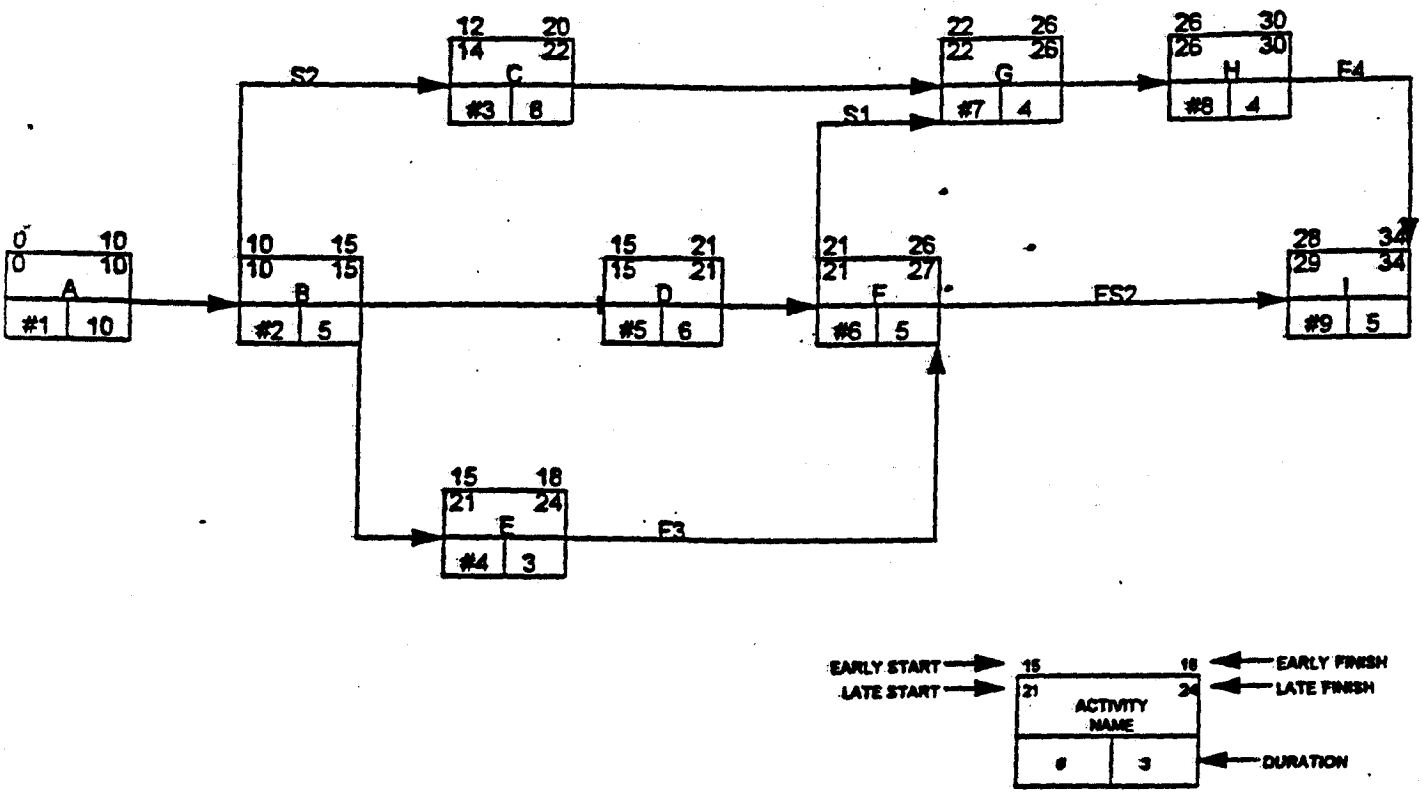
f. Activity Data. The most common data elements relevant to activities are as follow:

(1) Early Start (ES) is the earliest date an activity can be started. It is the earliest time the activity can start due to the latest early finish time of a predecessor activity or from a start lag from a predecessor activity. The ES for activity 5 is 15 (Figure 3-7).

(2) Early Finish (EF) is the earliest date an activity can be completed and is found by adding the duration (D) to the ES or from a finish lag from a predecessor activity. For Activity 6, EF is 26 (Figure 3-7) .

(3) Late Finish (LF) is the latest date an activity can be finished and permit the project to be completed on time.. It is derived by subtracting from the late start of a successor activity or by subtracting through a finish lag from a successor activity. For activity 4, the LF is 24 (Figure 3-7).

(4) Late Start (LS) is the latest date an activity can start without delaying final completion of the project. For any activity it is found by subtracting the duration time from the LF or by subtracting through a start lag from a successor activity. In Figure 3-7, the late start for activity 7 is LF minus the duration, or 26-4=22. The late start for activity 6 is the late start of activity 7 minus the one-day start lag, or 22-S1=21.


12 20
14 22
C
#3 8
22 26
22 26
G
#7 4
26 30
26 30
H
#8 4
S2
S1
F4
0 10
0 10
A
#1 10
10 15
10 15
B
#2 5
15 21
15 21
D
#5 6
21 26
21 27
F
#6 5
28 34
29 34
I
#9 5
FS2
15 18
21 24
E
#4 3
F3

EARLY START
LATE START
15
21
ACTIVITY NAME
18
24
EARLY FINISH
LATE FINISH
#
3
DURATION

Figure 3-7

(5) Total Float (TF) is the amount of time available for scheduling an activity. It is the time that start of an activity can be delayed beyond the ES without affecting the final completion date of the project. It is the difference between the early start and late start (LS-ES) or early finish and late finish (LF-EF) of any given activity. Notice that any of these calculations yields an answer of 0 for a critical activity. Total float must be calculated in one of the above ways since it does not appear directly on the diagram. In the Precedence diagramming system, if start to start or finish to finish lags are used, it is possible for the total float on the start and finish of an activity to differ. In such an instance the start float may be more critical (smaller) than the finish float or vice versa. Total float is the most significant float calculation. Free float(FF)is a feature which signifies only float available without affecting the next activity early start. The only concept that has significant value in contract management is total float. The critical path (TF=0) for Figure 3-7 is A (#1), B (#2),D (#5), S1 lag, G (#7), H (#8), F4 lag.

g. Activity Data. If start to start or finish to finish relationships are included, they may dictate the Early Start (ES), Late Start (LS), Early Finish (EF), or Late Finish (LF) dates for an activity in such a way that (ES) + Duration is not the (EF) and LF - Duration is not the (LS). This occurs when that the start to start lags and the finish to finish lags dictate a period between start and finish longer than the activity duration.